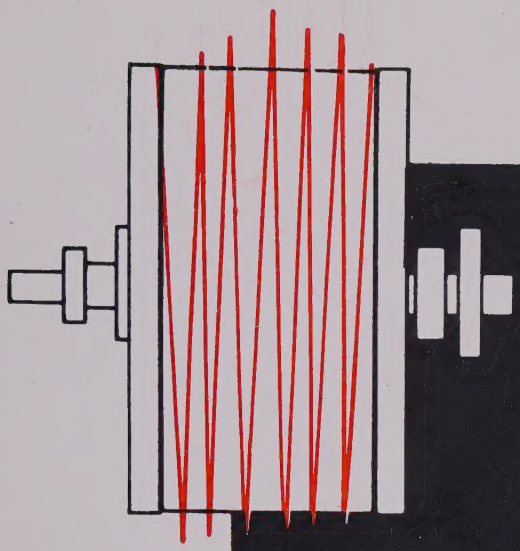
4605 4602C 4603 4636 4637



DYNAMOMETER OPERATING INSTRUCTIONS

MAGTROL, INC.

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MAGTROL DYNAMOMETERS AND ASSOCIATED EQUIPMENT

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1. DYNAMOMETER AND MODEL 4605 or 4603

1.1 Unpacking and Setup:

Unpack the dynamometer, control unit and digital readout from their respective shipping containers. Save the cartons and all packing material. In the event of shipping damage, the carrier should be notified immediately. This procedure is essential if a damage claim is to be initiated.

Place the dynamometer on a smooth, flat surface. The readout and control unit may be set up in any manner within the limit of the interconnecting cable lengths -- approximately four feet.

Connect the three interconnecting cables·

a. The 14 terminal cable into the dynamometer and readout.
b. The 2 pin brake control cable into the power supply.
c. The standard 117 VAC line cord from the dynamometer to the switched AC outlet on the rear of the Model 4605 or 4603 digital readout.

Be sure the ON-OFF switch is off and plug in the remaining line cords into a suitable 117 VAC 60 Hz power source.

1.1.1 Display Hold·

Two miniature banana jacks are located on the rear panel of the 4605 digital readout. When either or both of these are shorted, the readings are held indefinitely. If this function is desired, use either a D.P.S.T. (normally open) foot operated or toggle switch.

NOTE: For proper operation of the instrument, the line voltage source should remain within the limits of 105 to 125 VAC.

1.2 Operation·

Before switching the power supply model 4636 or 4637 on, check that the TORQUE CONTROL KNOB is fully CCW (OFF). If the special power supply model 4609 is used, refer to that section for setuo. Turn on the equipment. After a few seconds the axial cooling fan should be clearly audible in the dynamometer head. Spin the dynamometer output shaft; it should spin freely and the digital speed indicator should display an RPM reading. Digital torque is indicated on a digital voltmeter. The readings should be within ± 1 digit after approximately five minutes warm up.

After fifteen minutes, if the torque reading is not within ± 1 digit with the dynamometer shaft stationary and nothing connected to it, refer to paragraph 1.4.2. Otherwise, the unit is ready for operation.

1.2.1 Motor Attachment:

Never solidly couple shafts with bored out steel sleeves or the equivalent. A soft coupling is essential. For example, Lord Mfg. Company of Erie, Pa., "Type J-1211" usually is adequate, or any equivalent type.

Good shaft alignment cannot be overstressed, since poor alignment results in coupling losses. Generally, parallel off-set is more harmful than angular off-set, but both should be minimized.

1.2.2 Fixturing:

Any torque applied to the motor shaft is equally present on the motor frame. It is essential to secure the motor to the dynamometer base plate.

The base plate on Magtrol dynamometers is aluminum tool plate (cast). This has the advantage of being very flat and unstressed. However, tool plate is soft and "gummy" to machine. If motor fixtures are to be mounted to the base plate, chip clearing and generous use of cutting oil is recommended when drilling and tapping.

1.2.3 Motor Testing:

With the motor connected and ready for test, apply power to the motor. If the motor is of a type where danger of high speed "run away" or excessive speed is a hazard, increase the torque control until enough torque is applied to maintain a safe upper limit. Some torque will be present, even with the torque control off and the value should be regarded as a component of the data (refer to paragraph 1.5).

As the torque control is advanced CW, torque will be applied, the speed will typically decrease and these values will be indicated on the readout instrument.

A very important factor is kinetic power absorption. This limitation is covered in paragraph 1.7.

NOTE: After the shaft of a motor is coupled to the dynamometer, and is stationary, zero torque will not necessarily be indicated. Both the dynamometer shaft bearing and the motor friction drag may apply a component of torque.

1.3 Operating Principle:

All Magtrol dynamometers are equipped with a hysteresis brake. This is the means for applying torque to the test motor. The stator assembly provides an articulated and precisely defined magnetic field through the rotor. Since the stator assembly is composed of iron, the strength of the field magnetically is determined by the ampere turns of the stator coil. The rotor resists rotation dependent upon this field strength, thus resistance to rotation (torque) is dependent upon applied current. (See Figure 1)

As torque is developed on the rotor, the stator assembly reacts precisely the same amount. However, it is restricted from motion, except for a few degrees, by the load cell.

Since the shaft extends through the brake assembly, a photo optical pick-up is installed at the end of the shaft for speed transducing. Light from the exciter lamp beams directly into a high speed silicon photo-cell. Between the lamp and the photo-cell is a clear plastic disc with alternate clear and opaque segments. As the light is interrupted, the resistance of the photo-cell changes. With the application of a bias current on the cell, the resistance change results in generation of voltage pulses, the frequency proportional to the shaft speed.

1.3.1 Salient Pole Effect: (Cogging)

If power (Torque Control CW) is applied to the dynamometer at rest, the rotor and shaft will be locked by the amount of torque imposed. This is essential for motor locked rotor data. However, if the current is subsequently removed, in the absence of rotation, a history of the stator tooth structure is temporarily imposed on the rotor. (The rotor is a permanent magnet material). If the shaft is now rotated, torque pulsations will be present. This condition is frequently confused with defective bearings or other defects. It in no way impairs the accuracy or performance of the equipment. The cogging may be eliminated by rotating the shaft at any speed above a few RPM, re-establishing the same value of torque, then decreasing the torque to zero <u>while the shaft is rotating.</u>

1.4. Calibration:

1.4.1 Torque Explanation:

A simple means of calibration is provided with the use of the torque calibration beam supplied with the instrument. It is desirable to periodically check calibration. The calibration beam is supplied with two pins, one on each end, precisely spaced from the center of the beam.

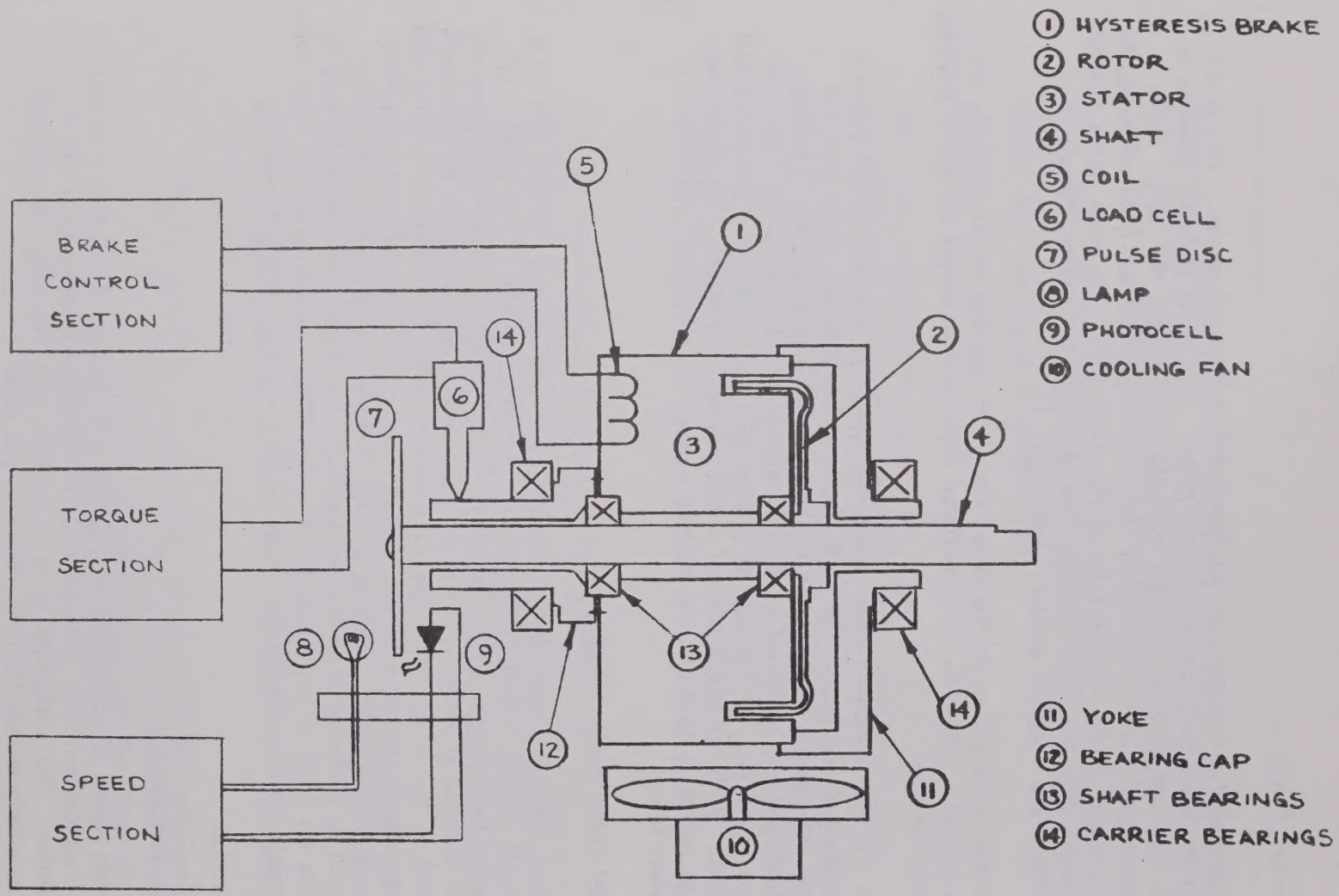


FIG. 1. MECHANICAL SCHEMATIC DIAGRAM

The actual distance is engraved on the beam, and varies with the size or specific dynamometer model. Refer to Figure 2.

As mounted, the center of the beam is directly on the centerline of the shaft. The torque applied to the shaft will be equal to the weight supported by the beam times the distance in inches. Figure 2 is a sketch of a typical calibration beam showing a 2 ounce weight attached at 5 inches. The torque applied to the shaft would be 2 ounces x five inches = ten ounce inches. To insure accuracy, a bubble level is supplied with the calibration beam to maintain the beam in a horizontal position throughout the entire calibration procedure. The following will result in accurate calibration of at least .25% + 1 digit.

1.4.2 Calibration Procedures:

a. Rotate the dynamometer shaft such that the flat on the shaft is facing down.

b. Advance the torque control CW to full torque.

c. Place the beam on the shaft with the level up.

d. Tighten the locking screw against the flat on the shaft.

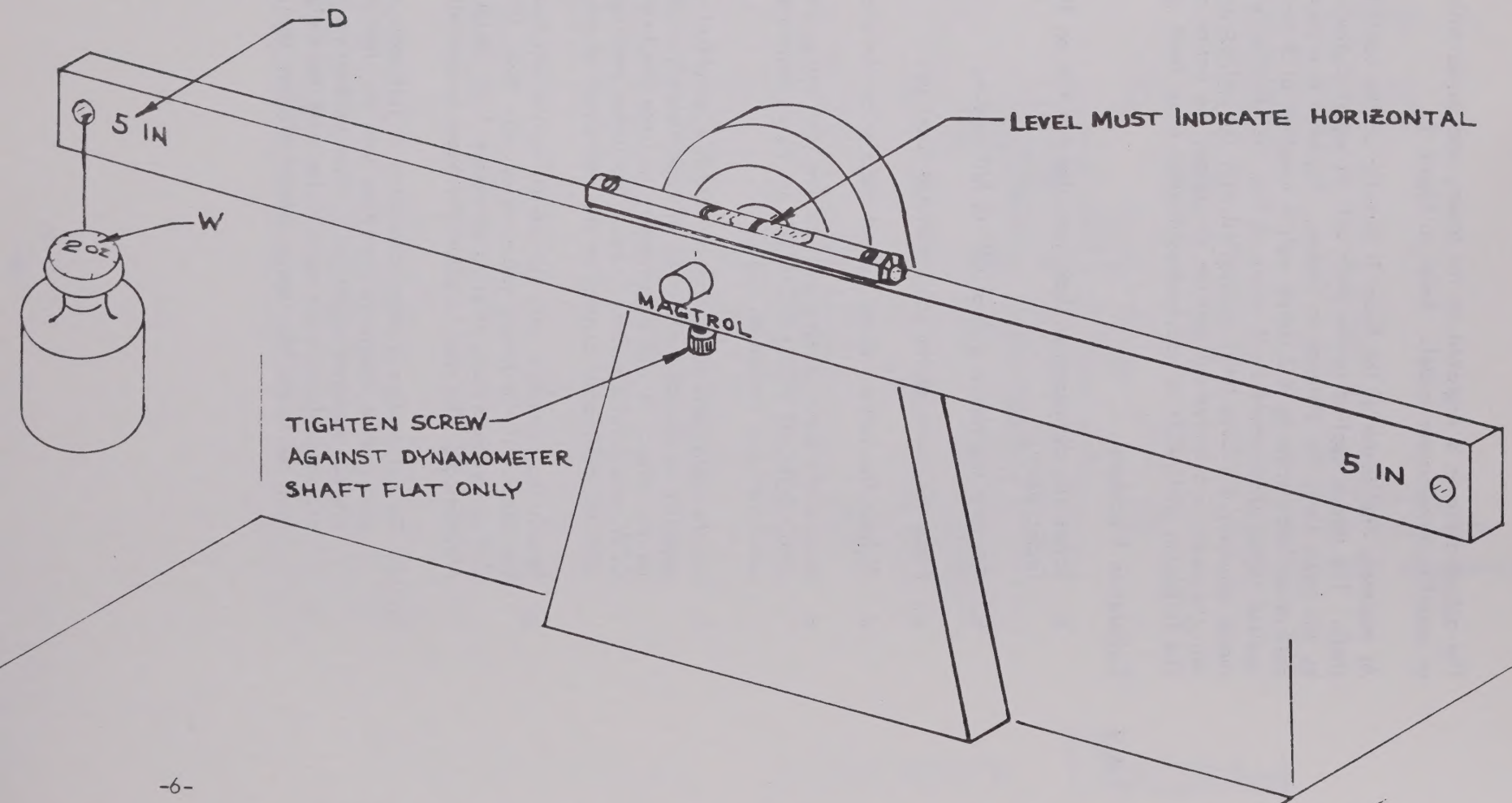
e. Be sure the beam is very still and not oscillating, set the ZERO TORQUE POTENTIOMETER on the dynamometer rear panel for zero indication (000).

f. On the right hand side carefully attach a weight of a suitable capacity to provide full scale, or approximately a full scale torque value. It will be necessary to force the beam CW or CCW to a level position. Check the torque reading, and correct with the calibration control on the rear panel as required.

g. Repeat the procedure with the weight on the left hand side of the beam. If the torque value varies more than .25% from the CW calibrated value, refer to paragraph 1.10 Alignment, Mechanical. (Be sure to adjust the beam horizontally.)

NOTE: Do not confuse a directional error at full scale torque, with a zero imbalance condition with the shaft free. These are two separate conditions. When calibrating full scale accuracy always make certain that with the weight removed from the beam, the torque readout displays zero.

TORQUE = W x D (CCW AS SHOWN)



1.4.3 Speed:

There is no adjustment or calibration procedure for the speed reading. Accuracy is dependent upon the 60 cycle line frequency, which is typically better than .02% (subject to local conditions). A speed error would be indicative of a component failure. The most simple method for determining accurate speed display is to operate the unit from a known motor, such as a two pole synchronous or other induction motor.

1.5 Mechanical Friction:

Some mechanical friction must exist due to the stator carrier bearings. These bearings are non-loaded, stainless steel, and contain only a light amount of thin oil. During normal operation, enough vibration is present to allow these bearings to "settle". However, with the dynamometer at rest and shaft disconnected, they may reflect a "stickiness" of .1% or less. The shaft (running) bearings cannot introduce any error, regardless of their condition, since they are supported in the stator assembly and any torque required to rotate them is read as part of the indicated torque value.

1.6 Windage:

Dynamic windage error is a function of the dynamometer size and the speed at which the unit is operated. Currents of air are generated on the rotor surface. Most of this is tangential to the rotor surface and impinges on the brake stator reaction member, resulting in a torque reading and is not error as such. However, some air must be dissipated as simple pumping loss and therefore, uncompensated.

Since the rotor is inherently a smooth surface, the practical value of windage pumping loss is small and difficult to establish quantitatively. Tests conducted on all sizes of Magtrol dynamometers indicate that at speeds approximately 25% above catalog maximum rating, the loss (error) is an order of magnitude equal to the least significant digit. Expressed as a percentage of full scale, this would be in the range of .025 to .25% with the larger figure tending toward the smallest capacity dynamometer.

1.7 Power Dissipation:

All Magtrol dynamometers are absorption types. With high torque and high speed, there are ultimate limits to which the equipment may safely absorb kinetic energy.

The actual power absorption member is the rotor portion of the brake assembly. Due to the close proximity of the rotor to the stator assembly, heat transfer to these members is rapid, and little thermal gradient exists. This aids the temperature problem, since there is a mass for "heat sinking" and thermal radiation. The maximum operating temperature is rated at 100° C., in consideration of bearing lubricants. This upper limit may occur by either moderate power input for a long period of time or high power for a short period of time.

To remain within safe limits for high power inputs, refer to the following power-time curves. From a knowledge of torque and speed or HP, watts may be readily determined by the following formulas:

$$1 \text{ HP} = 746 \text{ Watts}$$

or in the case of torque and speed:

$$\text{HP} = \frac{Q \times N}{5252}$$ Where Q = lb. ft.
N = RPM

or a less accurate, (8%) error, more simple formula:

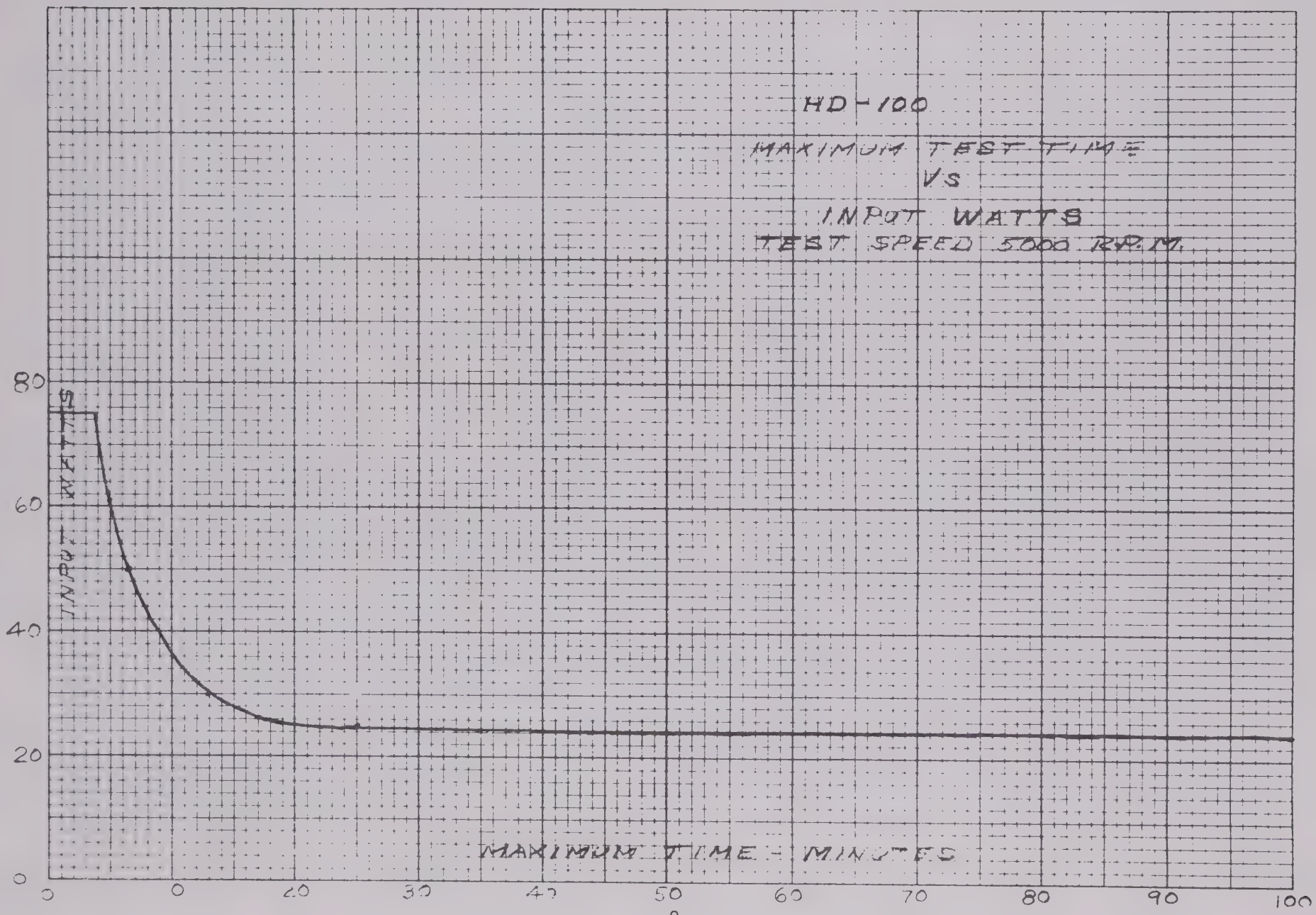
$$\text{HP} = Q \times N \times 10^{-6}$$ Where Q = oz. in.
N = RPM

I.E. 1/10 HP = 100 oz. in. at 1000 RPM

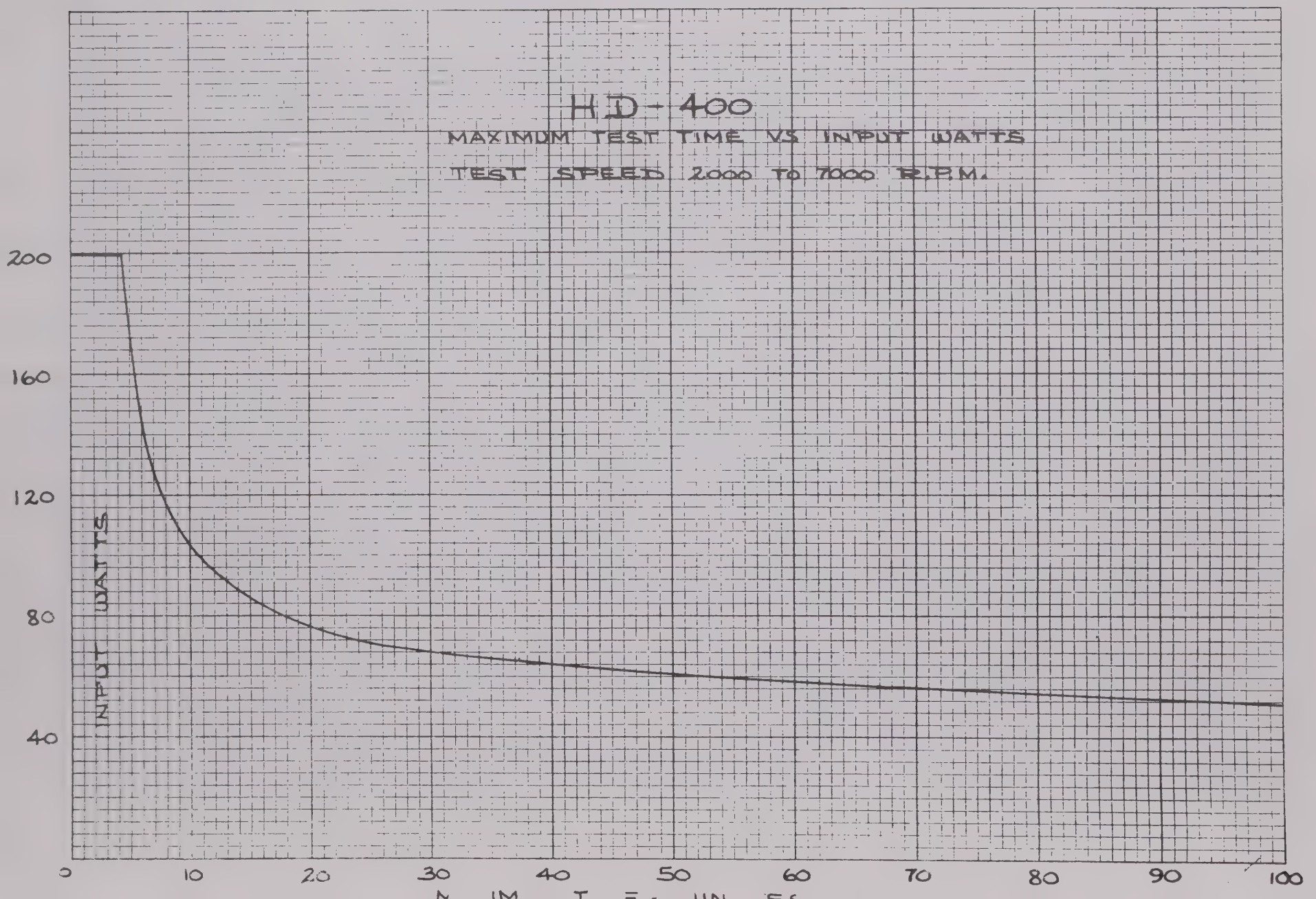
Example: HD700 Dynamometer and AC motor rated at 325 oz. in. at 1710 RPM

Therefore: $\text{HP} = 325. \times 1710 \times 10^{-6} = .55$ HP Watts = .55 x 746 = 410

Referring to the curves for the HD-700, we see that the instrument will absorb 410 watts for 16 minutes. This will result in the brake reaching a temperature of 100 C.

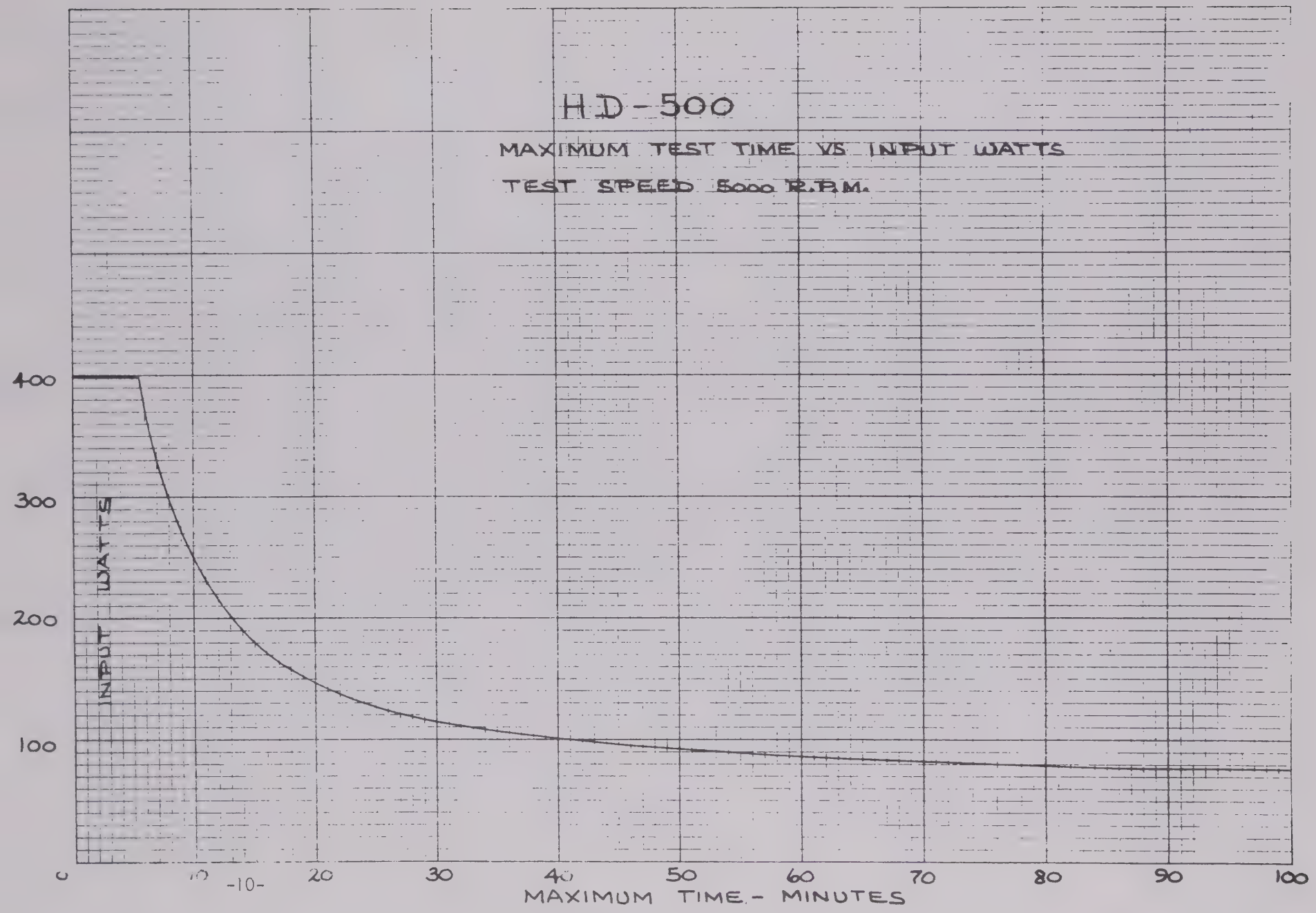

HD-100
MAXIMUM TEST TIME
VS
INPUT WATTS
TEST SPEED 5000 R.P.M.
INPUT WATTS
MAXIMUM TIME - MINUTES
0
20
40
60
80
0
10
20
30
40
50
60
70
80
90
100

E. E. 1-850C
10 X 10 TO THE INCH
ARLES #6 CO INC
MADE IN U.S.A.

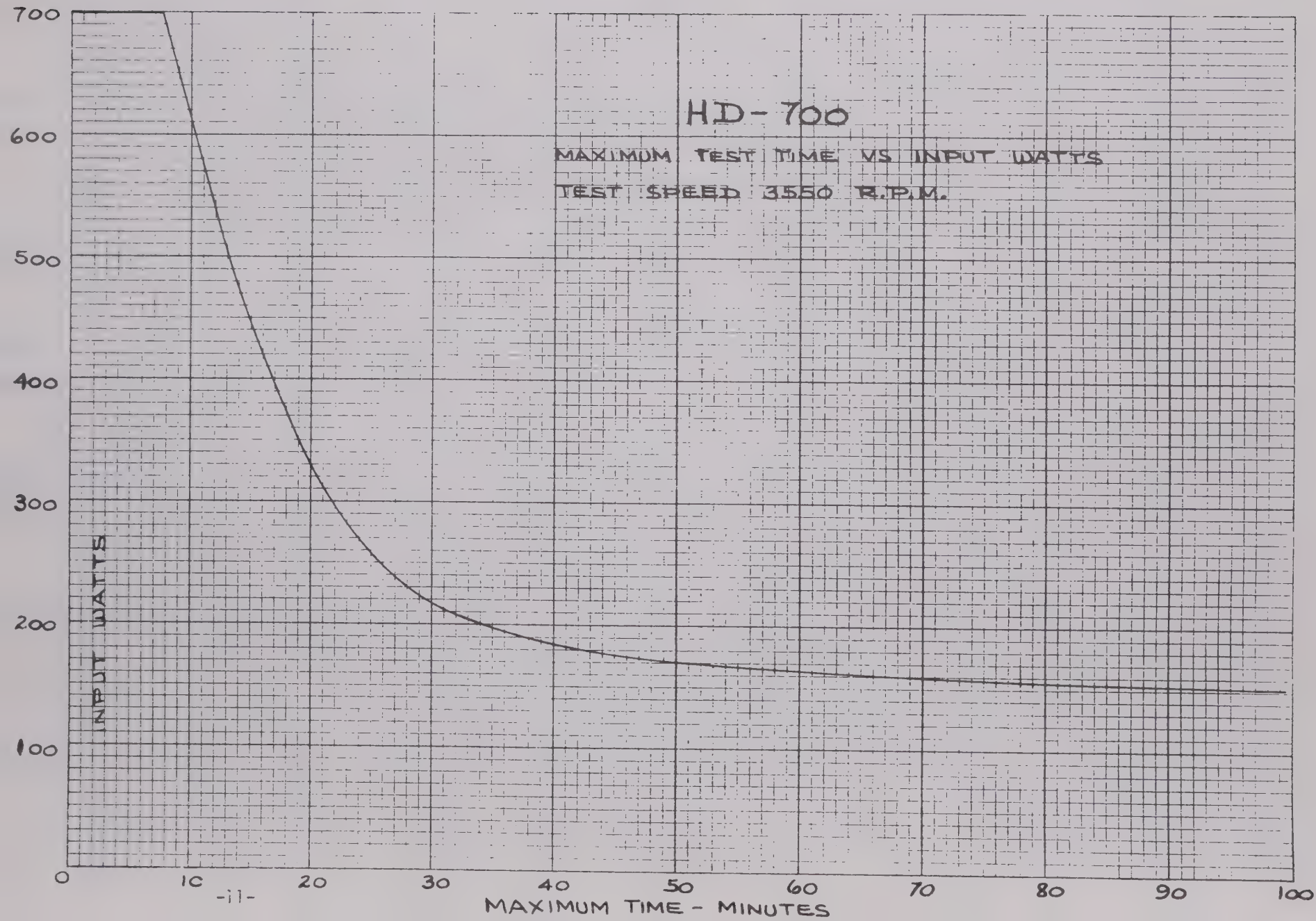


10 X 10 TO THE INCH MADE IN U.S.A.

L.P.

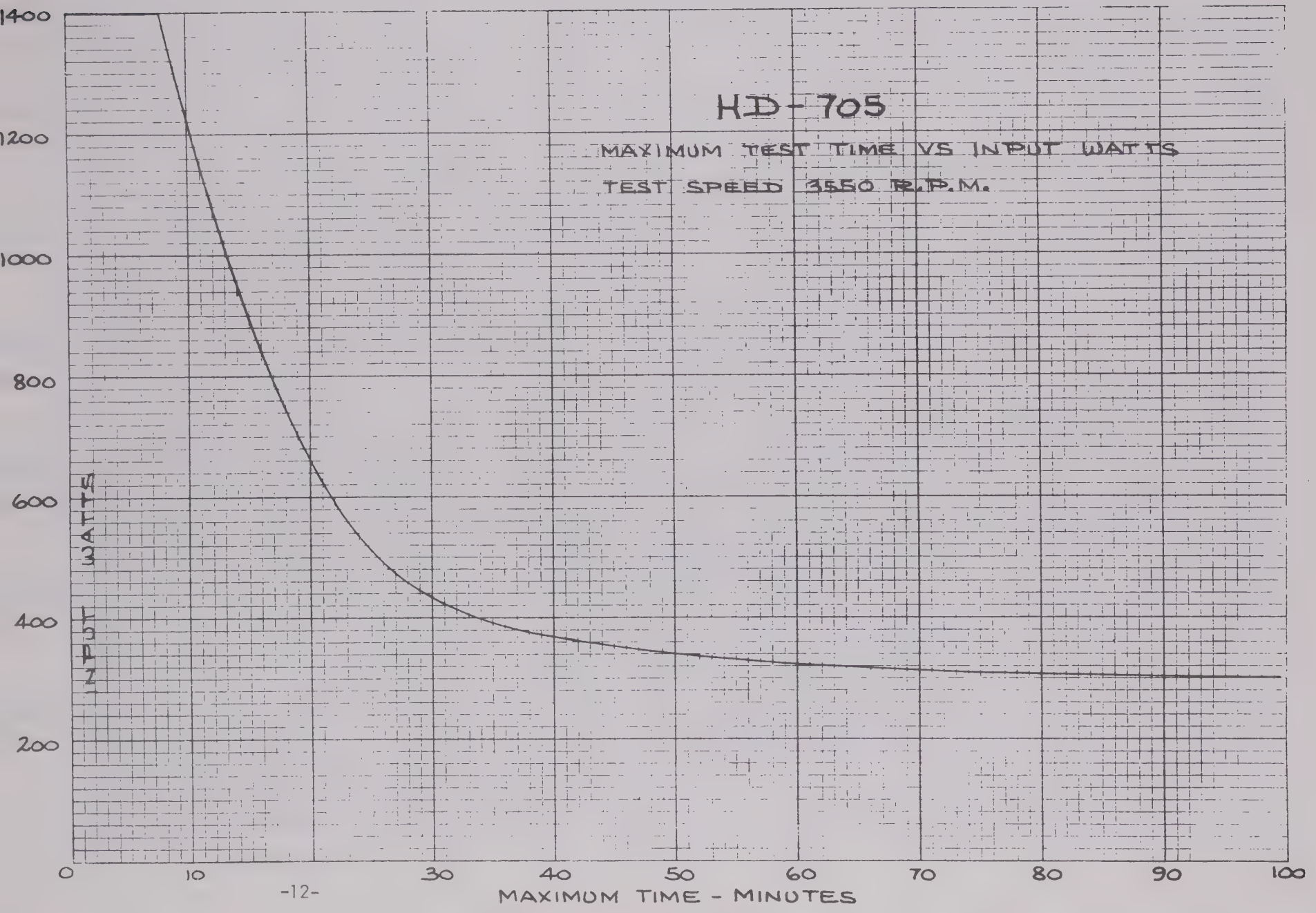


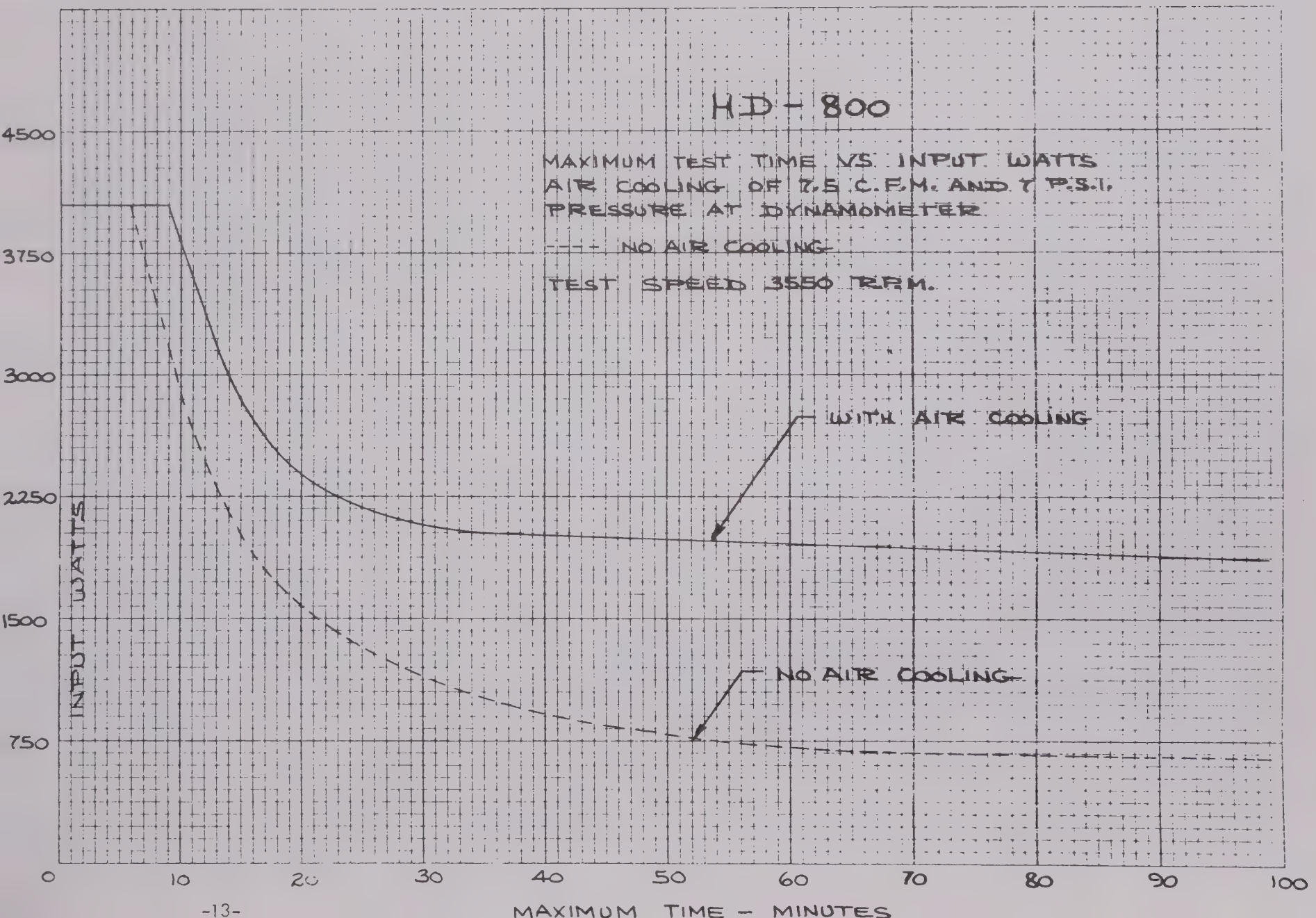
10 X 10 TO THE INCH
MADE IN U.S.A.

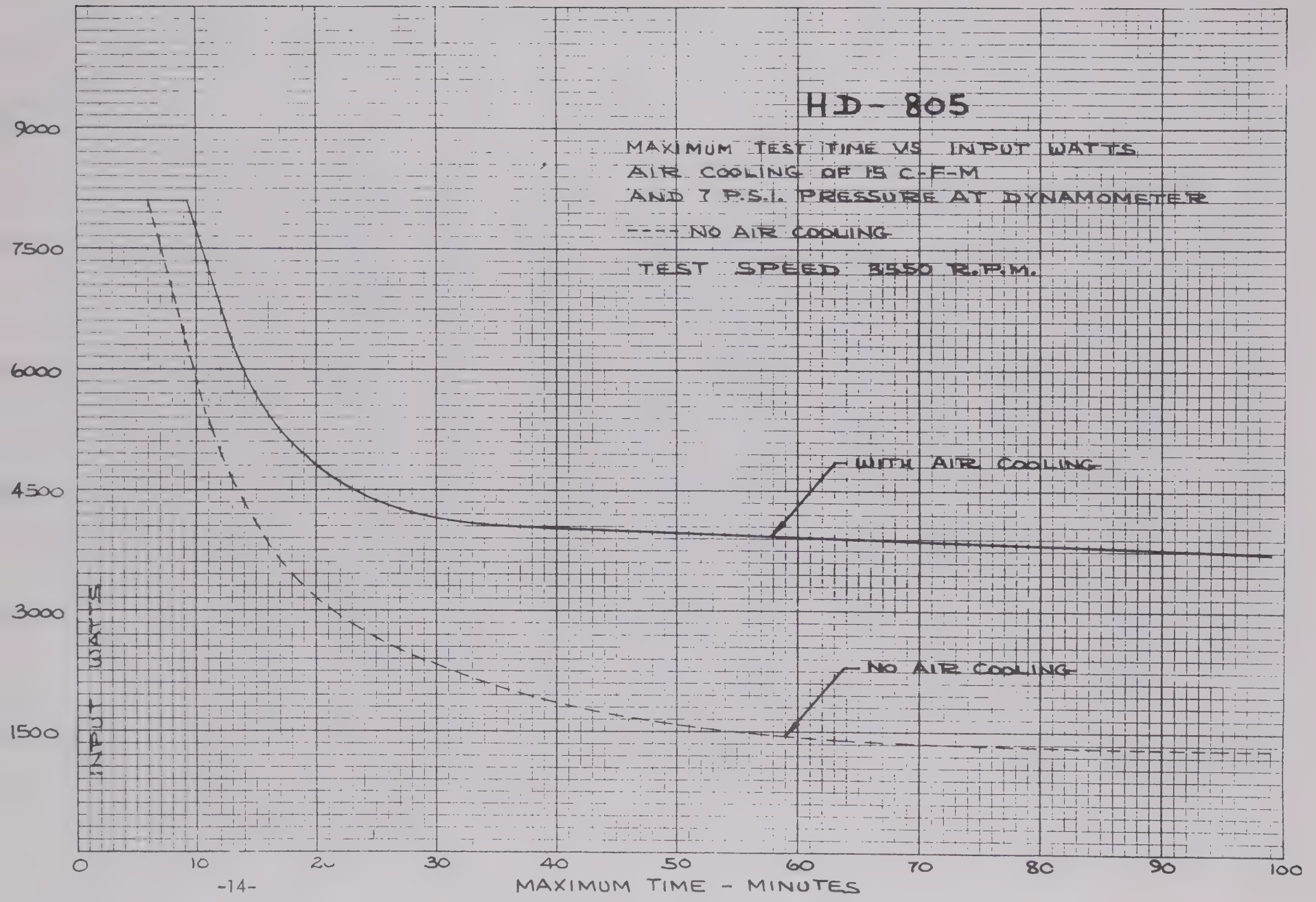


10 X 10 TO THE INCH

MADE IN U.S.A.




HD-800
MAXIMUM TEST TIME VS. INPUT WATTS
AIR COOLING OF 7.5 C.F.M. AND 7 P.S.I.
PRESSURE AT DYNAMOMETER
---- NO AIR COOLING
TEST SPEED 3550 R.P.M.
WITH AIR COOLING
NO AIR COOLING
INPUT WATTS
4500
3750
3000
2250
1500
750
0
10
20
30
40
50
60
70
80
90
100
MAXIMUM TIME - MINUTES


HD-805
MAXIMUM TEST TIME VS INPUT WATTS
AIR COOLING OF 15 C-F-M
AND 7 P.S.I. PRESSURE AT DYNAMOMETER
---- NO AIR COOLING
TEST SPEED 3550 R.P.M.
WITH AIR COOLING
NO AIR COOLING
INPUT WATTS
9000
7500
6000
4500
3000
1500
0
10
20
30
40
50
60
70
80
90
100
MAXIMUM TIME - MINUTES

1.8 Maintenance:

The only item requiring periodic maintenance is the air filter located inside the dynamometer enclosures.

- Remove two 6-32 screws from the top rear of the dynamometer enclosure.
- Slide the top cover straight back and remove.
- Remove the filter element by rotating the plastic frame inside the cabinet. It is unnecessary to remove the frame from the side plate.
- Wash the filter by holding it under a warm water tap. Shake off excess and reinstall it following the above procedure in reverse.

If the filter element requires replacement, it may be purchased from Magtrol, Inc., Part No. 7294 or Howard Industries, Model 3-90-8099 Filter Assembly. The only other items possibly requiring replacement are the dynamometer shaft bearings. Unless the dynamometer bearings are subjected to severe high speed -- high temperature operation, they should survive several thousand hours operation. If the bearings become noisy, they should be replaced immediately to avoid any possibility of seizure and subsequent damage to other members.

Replacement of the shaft bearings requires partial disassembly of the dynamometer.

1.9 Disassembly:

Disassembly should be performed by qualified personnel experienced in precision electro-mechanical instruments.

The extent of the disassembly is dependent upon the component requiring service. The following is a step by step procedure resulting in major disassembly for bearings or part replacement.

a. Remove all rear panel retaining screws.

b. Carefully slide the top cover off, and lay the rear panel down flat, leaving all lead wires attached. This exposes the dynamometer electronic assemblies and photo-cell pickup.

c. Remove the pulse disc from the end of the shaft.

d. Unsolder the dynamometer brake lead wires from the two outside terminals of the photo-cell block.

e. Loosen (do not remove) the load cell clamping screw (top of load cell) two or three turns.

f. Lift the base plate from the front and reaching under the base plate, remove the two screws retaining the front pillow block.

g. Resting the unit flat, grasp the front pillow block and simultaneously apply an upward force on the dynamometer shaft to relieve the weight; slide the pillow block and front panel assembly straight forward off the yoke.

h. Reach to the rear of the brake assembly and grasp the load cell. Also grasp the brake assembly and with a twisting motion, pull the brake assembly forward <u>just free</u> of the load cell.

i. Place the load cell on the top of the photo-cell block, (tape it down, if necessary). Do not pull excessively on the lead wires and do not touch or allow anything to touch the foil strain gages.

j. Feeding the brake lead wires (previously disconnected in Step d) through the upright, remove the brake assembly straight forward and out.

k. Remove the three bearing cap retaining screws. Remove the bearing cap, which is an assembly of a steel member and a phenolic thermal insulator.

On the HD-705, a rear yoke is used instead of a bearing cap. This is attached to the case by two screws. When the yoke is slipped off, allow the lead wires to feed through the hole carefully, so as not to snag.

l. Remove the front yoke by removing the two retaining screws.

m. With snap ring pliers, carefully remove the snap ring on the shaft at the back of the brake. Do not spread the ring too wide.

Snap rings are not used on the HD-705. The rear rotor is retained by set screws in the hub. Remove both set screws completely.

n. Grasp the shaft at the rotor end and pull the rotor shaft out of the brake. On the HD-705, use a twisting action on each rotor, and the rear rotor will slide off the shaft. When re-assembling the HD-705, do not push the rotors together too tightly. Approximately .003" end play is desirable to permit thermal expansion. Also, when re-assembling, be sure the set screws line up with the flats on the shaft and are tightly installed.

The shaft bearings may be removed from the brake assembly.

Further disassembly of the brake is not recommended, since special jigs and fixtures are required.

Re-Assembly Procedures:

Follow the preceding paragraphs in reverse, and observe the following points:

- On HD-106 thru HD-700 models, do not overtighten the button head screws that attach the bearing cap. Excessive pressure could crack the phenolic material.

- With the brake assembly re-installed in the upright, slip the load cell aluminum spacer washer over the bearing cap against the upright carrier bearing inner race. Install the load cell tightly against the spacer, such that the carrier bearing inner race is trapped and secure.

- Level the brake such that the front yoke is horizontal and tighten the load cell clamp screw.

- Feed the brake lead wires through the upright 3/16" diameter hole provided, and re-solder later. Do not pull the wires tight.

- It may be necessary to reset the mechanical "V" stops on some models. Refer to paragraph 1.10.2 Alignment.

- When installing the front pillow block, start the screws in by hand and before tightening, pull the pillow block forward for maximum clearance between pivot bearings.

- Re-solder the brake lead wires on the two outside terminals of the photo-cell block. (No polarity.)

a. Loosen the four 5/16" cap head screws that mount the front pillow block to the base plate. Do not remove the screws, simply loosen them one or two turns.

b. From under the base plate, locate and tap out the two dowel pins locating the front pillow block. Use a drift and mallet and tap the pins such that they fall free of the upright casting.

c. Lay the unit flat (normal position) and remove the four rear panel retaining screws. Reach inside the dynamometer housing and remove all four of the 1/4 - 20 cap screws that retain the housing to the base plate. The two front screws are difficult to see , but are located at each front corner. Disconnect or remove the axial fans (2) from the housing.

d. Lift the entire housing assembly straight up. The front panel is fixed to the front pillow block and must slide in each corner channel. When the housing is clear of the front panel, set it aside.

e. Remove the pulse disc from the end of the dynamometer shaft.

f. Unsolder the dynamometer brake lead wires from the two outside terminals of the photo-cell block.

g. Loosen (do not remove) the load cell clamping screw (top of load cell) four or five turns.

h. With wooden block or small jack standard, relieve the dynamometer brake weight from the carrier bearing in the front pillow block.

i. Remove the four 5/16" cap screws retaining the front pillow block casting, and remove the pillow block with the front plate attached.

j. Remove the load cell by sliding it off the rear support assembly. This must be done with care. The lead wires are still attached to the load cell. Grasp only the collar section of the load cell; do not touch the leaf portion or strain gages. Gently allow the load cell to rest on the photo-cell pick up block and tape it down, so that it is secure and the lead wires are unstressed. Do not remove the pivot bearing assembly.

k. Disconnect the air line at the mounting block, from the brass fitting. Slide the brake assembly forward and free of the rear upright.

l. Remove the three bearing cap retaining screws. Remove the bearing cap, which is an assembly of a steel member and a phenolic thermal insulator.

On the HD-805, a rear yoke is used instead of a bearing cap. This is attached to the case by four screws. When the yoke is slipped off, allow the lead wires to feed through the hole carefully so as not to snag.

m. Remove the front yoke by removing the two retaining screws.

n. With snap ring pliers, carefully remove the snap ring on the shaft at the back of the brake. Do not spread the ring too wide.

Snap rings are not used on the HD-805. The rear rotor is retained by set screws in the hub. Remove both set screws completely.

o. Grasp the shaft at the rotor end and pull the rotor shaft out of the brake. On the HD-805, the rear rotor will slide off the shaft. When re-assembling, do not push the rotors together too tightly. Approximately .010" end play is desirable to permit thermal expansion. Also, when re-assembling, be sure the set screws line up with the flats on the shaft and are tightly installed.

The shaft bearings may be removed from the brake assembly.

Re-Assembly Procedures:

Follow the preceding paragraphs in reverse and observe the following points:

- On the HD-800 models, do not overtighten the button head screws that attach the bearing cap. Excessive pressure could crack the phenolic material, weakening the assembly.
- With the brake assembly re-installed in the upright, slip the load cell aluminum spacer washer over the bearing cap against the upright carrier bearing inner race. Install the load cell tightly against the spacer, such that the carrier bearing inner race is trapped and secure.
- Level the brake so that the front yoke is horizontal and tighten the load cell clamp screw.
- Resolder the brake lead wires on the two outside terminals of the photocell blocks. (No Polarity)

1.10 Mechanical Alignment:

1.10.1 Load Cell Stop Bearings:

In order to provide a means for canceling directional torque differences, the load cell pivot bearings are retained in a bushing locked in the upright by a set screw.

Initially, this is adjusted at the factory and no subsequent re-adjustment is anticipated. If the load cell should be replaced by a new one, then an adjustment of the pivot stop might be necessary.

Set up the calibration beam as outlined in paragraph 1.4.2. If the procedure shows an excessive directional error, proceed as follows:

a. Remove the rear panel mounting screws.

b. Remove the top plate.

c. From the bottom of the base plate remove the four outside cap head screws that retain the housing onto the base plate. Remove the housing.

d. On the left hand edge, (rear view) of the rear upright is a set screw, back this set screw off approximately one turn.

e. Energize the dynamometer. From the procedures outlined in paragraph 1.4.1 note the CW vs. CCW error. With a drift punch and mallet, tap gently on the top or bottom pivot bearing shaft in a manner to rotate the pivot support as follows:

   If the torque is high CW, tap the bottom pivot shaft in. (Do not strike the bearing, and start out tapping lightly) If the torque is highest CCW, tap the top pivot shaft. By this manner, remove 1/2 of the error only, since whatever is subtracted from the one direction will automatically add to the other. Be sure to maintain the calibration beam horizontally, since this will be altered as the pivot rotates, however slightly.

f. After this alignment is satisfied, lock the bushing with the set screw, re-check, then re-assemble the housing and fan.

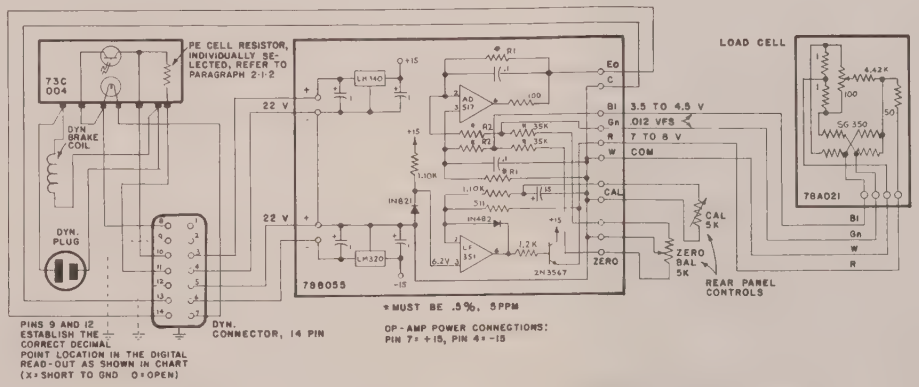
g. Note: Do not jam the pivot bearings into the leaf. The total adjustment should be no more than a few degrees from vertical.

1.10.2 V Stop Adjustment:

Adjust the stop as follows:

a. A hole is provided at the rear of the upright to expose the moving member of the V stop. Use an Allen wrench to loosen the stop. Do not remove it.

b. The stationary portion of the stop is secured by two screws located at the front of the upright. Loosen this member and push it toward the center. While maintaining pressure, lock down the rotating member tightly.



DYN. MODEL	ENGLISH (-6) PINS 9	PINS 12	FULL SCALE VALUE	UNITS	R2	R1	METRIC (-7) PINS 9	PINS 12	FULL SCALE VALUE	UNITS	R2	R1	BRAKE COIL RES.
HD 106	O	X	2.50	OZ IN	9K	500K	X	O	180.0	GM CM	4.99K	1.5M	171
HD 100	O	X	11.00	OZ IN	12K	950K	O	O	800	GM CM	9K	500K	180
HD 400	X	O	40.0	OZ IN	9K	300K	O	X	2.80	KG CM	10K	200K	80
HD 500	X	O	120.0	OZ IN	9K	850K	O	X	8.50	KG CM	10K	750K	120
HD 700	O	O	425	OZ IN	9K	300K	X	O	30.0	KG CM	10K	250K	80
HD 705	X	O	50.0	LB IN	9K	350K	X	O	60.0	KG CM	10K	500K	40
HD 800	X	O	100 0	LB IN	9K	850K	X	O	120.0	KG CM	8K	950K	60
HD 805	O	O	200	LB IN	9K	170K	O	O	240	KG CM	9K	200K	30

MAGTROL, INC.

DETAIL NO	NO / ASS'Y	MATERIAL SPEC	L	W	H	DIA	REMARKS
BILL OF MATERIAL							

SCALE	TOLERANCES		PROTECTIVE FINISH
F	FRACT. - ±1/64	.XXX - ±.005	XX SURFACE FINISH MICROINCHES
	.XX - ±.010"	ANG. - ±1/2°	

	DRAWN	CHECKED	APPROVED	TITLE	NEXT ASS'Y
DATE	2/5/82				
BY	TRW				DRG NO

LETTER	DATE	BY	ENG'R CHG NO.	CHANGE
REVISIONS				

MAGTROL, INC.

c. Back off the stationary member all the way by pulling it away from the center line of the unit. Lock it in place.

NOTE: The purpose of the stop is to limit the maximum excursion of the brake to 25% above full scale in both directions.

2. MODEL 4605

2.1 Circuit Description:

The electronics are in two sections. Torque and speed.

2.1.1 Torque Transducing:

The stator assembly of the dynamometer is restricted from motion by the load cell. The load cell consists of a strain member with foil-type gages bonded to it, forming a basic bridge network. In addition to the strain gages, there is a temperature sensing element which compensates the bridge for apparent strain and gage factor errors. Apparent strain appears as a zero drift and must be individually compensated on each load cell.

All the interconnections and component installations are contained on the circuit board attached to the load cell. Adjustment of the zero trim potentiometer on the load cell is covered under electrical alignment paragraph 3.1.2. Refering to the dynamometer schematic diagram; current is applied to the bridge through the red and white wires interconnecting the amplifier-power supply P.C. Board to the load cell assembly. When the bridge is unbalanced, a voltage is produced at the green and blue lines. The magnitude of this voltage is approximately .012 VDC for full scale. The green wire connect to the (-) input side of the operational amplifier. The blue line is common and connects to the "0" supply line.

Calibration of the system is accomplished by adjusting the load cell current with the variable resistor marked CALIBRATION. The ZERO adjust potentiometer imbalances the bridge, compensating for any combined inherent imbalance of the individual strain gages, operational amplifier and readout meter. (See Para. 1.4.2)

The load cell amplifier requires ±15 VDC. The power supplies for this are contained on the amplifier circuit board and consist of integrated circuit precision regulated power supplies. The voltage input to the dynamometer is in three isolated sections located on pins 1 through 6 of the 14 pin dynamometer connector.

2.1.2 Speed Transducing:

The tachometer pickup is a block consisting of a lamp, photo-cell, resistor and terminals. Referring to Figure 5, this assembly is identified by Magtrol Part Number 7116, including the pulse disc mounted on the dynamometer shaft. The photo-cell block must be located so as to place the pulse disc close to the photo-cell window in the approximate center of the 60 bit outside track. (50 bit for 50 Hz Power Line) The printed side of the disc should be toward the photo-cell for best definition.

The disc must clear the photo-cell with all axial tolerance taken up in the direction of contact. (Pulling out on the dynamometer shaft, motor end). However, it should not be spaced away more than .040 inches.

Referring to the dynamometer schematic, a regulated potential of +16 VDC is applied to pin 11 at the input connector to the current control resistor mounted on the photo-cell block. The photo diode is in a series and is the ground return for the applied voltage. As light causes the cell to conduct (low resistance), the voltage on the signal line and connector pin 10 is low. Alternately, as light is cut off, the signal voltage rises.

For information on the tachometer section, refer to Section 8, Mode 4602C.

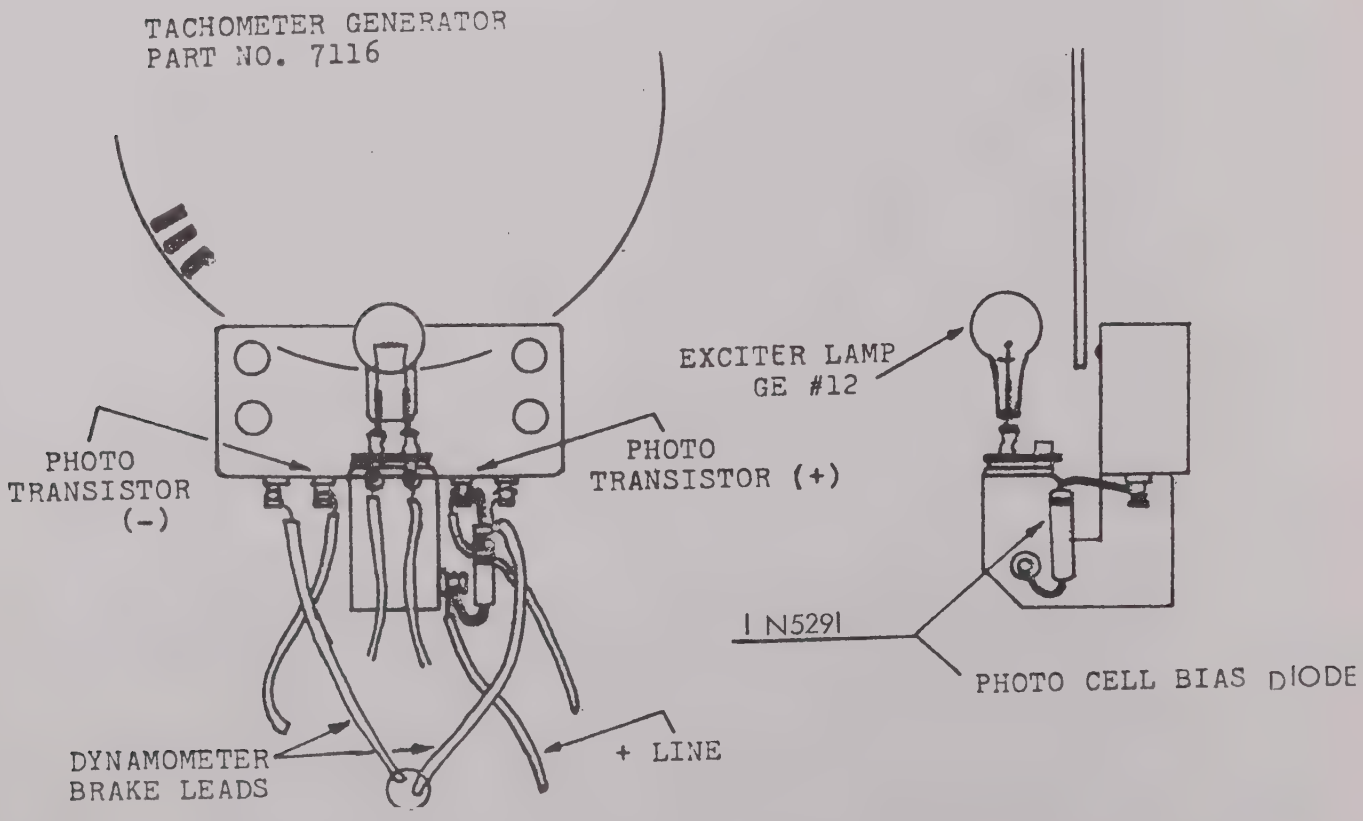
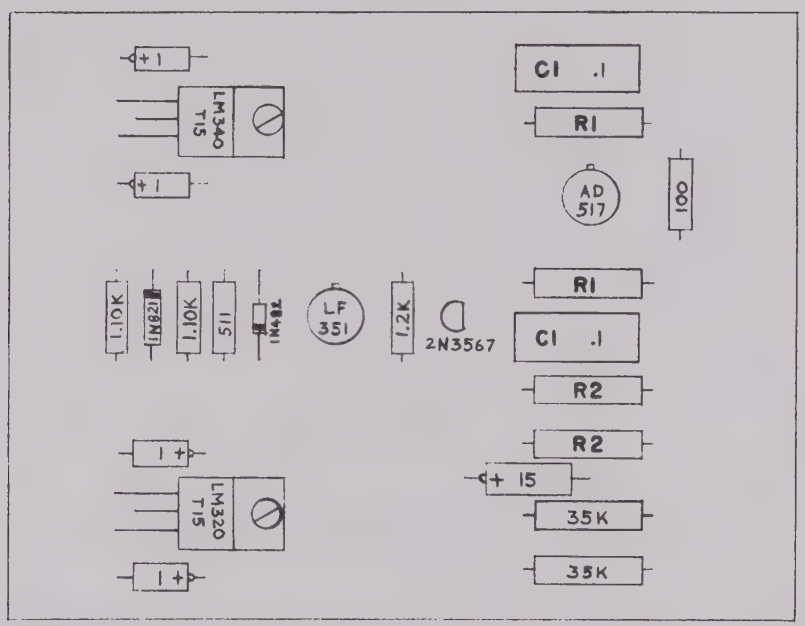


FIGURE 5.



C1 TORQUE DAMPING CONTROL CAPACITORS

R1 CALIBRATION CONTROL RESISTORS

OP-AMP PC BOARD

3. ALIGNMENT ELECTRICAL:

3.1 Load Cell:

The load cell is retained on the rear stator assembly by one screw; acting as a split clamp to facilitate the rotational alignment of all assemblies.

The electrical portion of the load cell consists of four bonded strain gages, one bonded "modulas vs temperature" resistor and a circuit board to facilitate wiring and provide a "fine" balancing technique.

Additionally, on most units a coarse balancing resistor is necessary to offset the individual strain gage elements by shunting the highest resistance gage. The following procedure is offered as a means of establishing the correct value of this resistor. It is necessary only in the event the torque readout cannot be adjusted to zero by the "ZERO" control on the rear of the dynamometer cabinet.

1. Remove the top cover on the dynamometer and allow the rear panel to lay nearly flat.

2. Mechanically center the "ZERO" control potentiomenter on the rear panel.

3. Rotate the trim pot mounted on the load cell P.C. board 20 turns clockwise; followed by 10 ± 1 turn C.C.W.

4. Observe or record the torque reading. Using any resistor of approximately 2.0 megohms resistance, connect this resistance (hold it across, do not solder) across the blue and white wire, (terminals) under the load cell. Observe the torque reading. If the reading is greater in magnitude, then shunting is required across the green and white lines. If the reading is less in magnitude, then the blue and white wires are correct.

5. Replace the resistor by a decade box, or using a quantity of resistors from 47K to 1 meg, determine the correct value to bring the torque readout to within 10 counts of absolute zero.

6. Zero the reading by adjusting the load cell trim pot and re-assemble the cabinet.

7. If the "ZERO" calibration changes by more than ± 2 counts after this procedure, and/or if the resistor selected is less than 47K, the load cell assembly should be replaced.

NOTE: The resistors utilized for balancing must be a minimum of 100 P.P.M., RN 60C (or equivalent) quality. Carbon composition or deposited film resistors of greater than 100 P.P.M. temperature stability are unsatisfactory for this application.

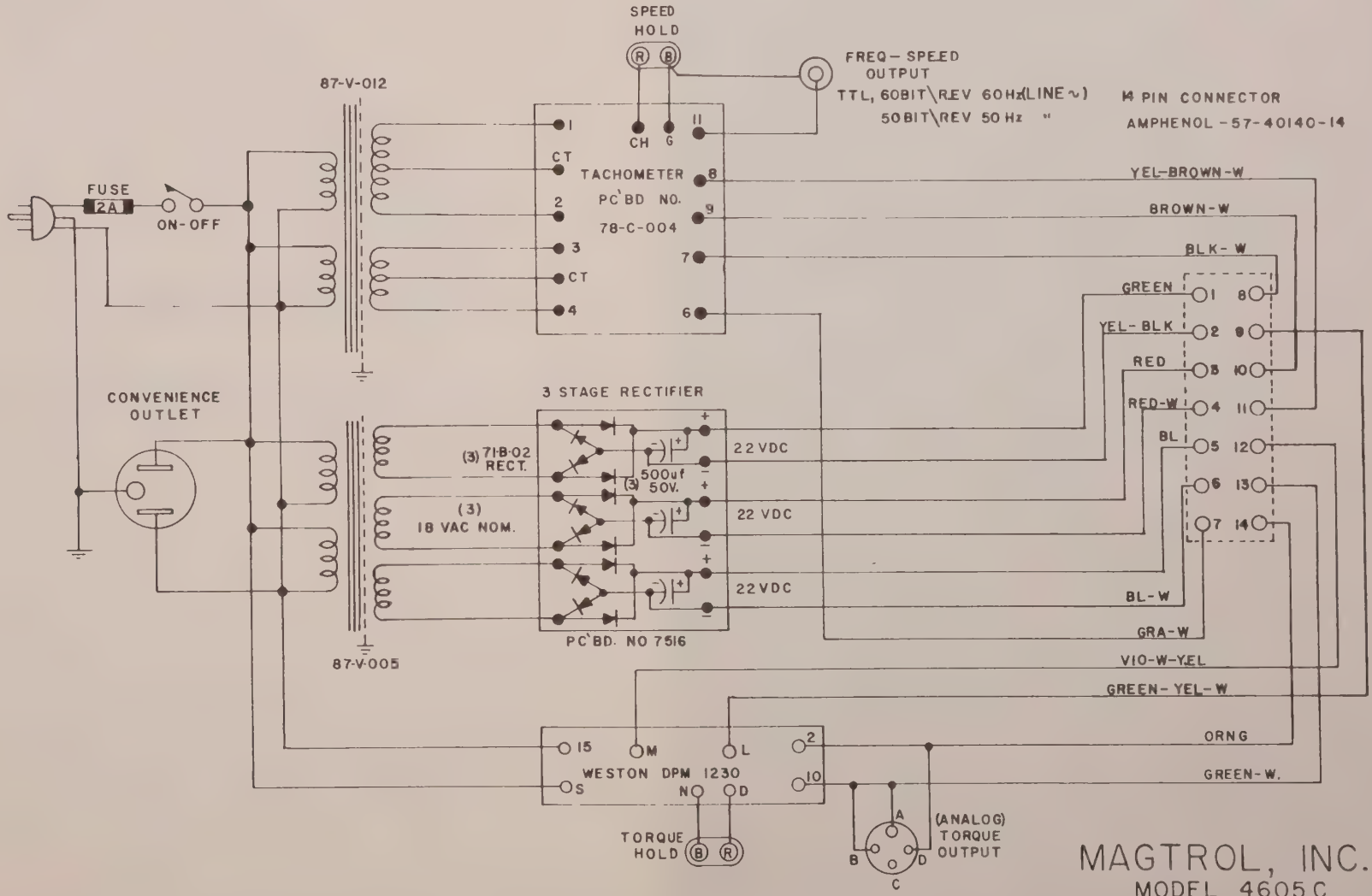
4. DAMPING:

It may be desirable to reduce the torque response time. This may be accomplished by increasing the value of the damping (or feed back) capacitor. The torque amplifier section is mounted on the rear panel, inside the dynamometer. Remove the four rear panel retaining screws. Slide the top cover back a few inches. Figure 4 indicates the location of the damping capacitor. Increasing this capacitor to .1 MFD or 1. MFD will provide the desired effect. Be sure to check and re-adjust calibration, if necessary, referring to Paragraph 1.4.2.

Use only high quality mylar or poly-carbonate capacitors. Do Not use polarized capacitors for this application.

Mechanical damping to reduce resonent frequencies in the dynamometer is accomplished by an oil filled dash pot mounted to the side of the dynamometer brake. No service to this assembly is possible, or anticipated.

The unit contains a labyrinth type seal and no friction elements or sliding seals are utilized.


SPEED HOLD
R
B
FREQ – SPEED OUTPUT
TTL, 60BIT\REV 60Hz(LINE ~)
50BIT\REV 50 Hz "
14 PIN CONNECTOR
AMPHENOL – 57-40140-14
87-V-012
FUSE
2A
ON-OFF
CONVENIENCE OUTLET
CH
G
1
CT
2
3
CT
4
11
TACHOMETER
PC BD NO.
78-C-004
8
9
7
6
YEL-BROWN-W
BROWN-W
BLK-W
GREEN
YEL-BLK
RED
RED-W
BL
1
2
3
4
5
6
7
8
9
10
11
12
13
14
3 STAGE RECTIFIER
(3) 718-02 RECT.
(3) 500uf 50V.
(3) 18 VAC NOM.
22 VDC
22 VDC
22 VDC
PC BD. NO 7516
87-V-005
BL-W
GRA-W
VIO-W-YEL
GREEN-YEL-W
ORNG
GREEN-W.
15
M
L
S
N
D
2
10
WESTON DPM 1230
TORQUE HOLD
B
R
A
B
C
D
(ANALOG) TORQUE OUTPUT
MAGTROL, INC.
MODEL 4605C

5. MODEL 4602C DIGITAL TACHOMETER

5.1 Specifications:

Power Input:	10 Watts Maximum 117 VAC 60 HZ 230 VAC 50* or 60 HZ
Speed Range:	Above 35,000 R.P.M. (refer to dynamometer speed rating)
Display:	.55 Character, flat plane gas discharge. Continuous indicating with zero blanking.
Accuracy:	Line frequency, typically .01% $\pm$ 1 count.

*For 50 Hz operation the dynamometer must be equipped with a 50 bit/rev. pulse disc; Magtrol part number 89-D-002.

5.2 Incoming Inspection:

Upon removal of the instrument from the shipping carton, inspect the unit for obvious damage. Retain the packing material until an operational check has been performed. In the event of damage or shipping abuse, the carrier should be notified for inspection of the equipment and the packing material.

5.3 Set Up and Operational Check:

-Plug the unit into a suitable line source.

-For the protection of operating personnel and in compliance with the National Electrical Manufacturers Association (NEMA) recommendations, this instrument is equipped with a three-conductor power cable. When used with a suitable outlet, earth grounding of the cabinet is obtained.

-Connect the dynamometer 6 pin plug into the socket provided on the rear panel. If the 4602C is used with other Magtrol special purpose power supplies (4609 or 4634 or 4603), a cord set is provided to interconnect the units.

-Turn the unit on.

-Spin the dynamometer shaft by hand and observe if a count is displayed. If a count is displayed, then it can be assumed that the instrument is operating properly.

-If the unit is inoperative, assume shipping damage and contact "Dynamometer Customer Service" at the factory for instructions.

5.4 Operating Characteristics:

The 4602C Digital Tachometer is basically an "events" counter which, when equipped with a time base, becomes an events per unit of time indicator, or frequency counter.

Since a period of time is necessary to accumulate a count, the read-out is the average speed over the count period of .5 seconds for 60 Hz and .6 seconds for 50 Hz.

All Magtrol digital dynamometers are equipped with an optical shaft encoder for speed transducing. The explanation of this assembly is covered by paragraph 2.1.2.

Two types of encoder discs are used. For 60 Hz operation, a 60 bit per revolution disc is used, Magtrol P/N 89-D-001. For 50 Hz service, a 50 bit per revolution disc is necessary, P/N 89-D-002.

On the rear panel of the 4602C Tachometer or the 4605 Torque-Speed indicator, a frequency output is provided on a miniature phone jack. This frequency is proportional to speed at a rate of either 50 or 60 pulses per revolution. The output is TTL level signal in series with 4.7K resistor.

5.4.1 Noise and Erratic Performance·

High speed integrated circuits are susceptible to high frequency transient noise. Some commutated AC-DC motors product high current "spikes" which transmit as R.F. noise. This combination can, under the right conditions, cause an occasional reading error.

The noise may be induced by either or both the line power or R.F. pickup. The solution is isolation of the line or shielding from the R.F. noise, or both.

Line Isolation:

Generally, noise is more easily eliminated at the source. If this is not practical, a small electrostatically-shielded line isolation transformer on the 4602C will usually suffice. A power rating of 25 watts is adequate.

Shielding:

A grounded metal barrier may be necessary between the motor and the readout equipment in extreme situations. Separation and shielding of the input lines to the tachometer and input lines to the motor may be necessary.

5.4.2 Circuit Description:

5.4.2.1 Power Supply:

All power to the unit is obtained through a transformer P.N. 87-V-012. This transformer has a "split primary" which series connected, sets up the transformer for 230 VAC 50 or 60 Hz; parallel connected is 115 VAC.

Two levels of power are required:

1. 5 Volt D.C. logic level, operating at approximately 0.8 amps.
2. 200 Volt D.C. source of power for the gas discharge displays.

Referring to the Schematic diagram 78-B-004-005. The 5 volt logic level may be checked at any approximate point identified as Vcc. The 200 VDC level exists only on the upright PC Board containing the readout indicators.

5.4.2.2 Time Base:

The time base sections used a signal from the transformer secondary to trigger a N74121 one shot, after suitable diode steering and current limiting. The output of the N74121 is divided by 3 using the N7473 Dual JK. This division process yields a pulse of approximately 80 ms. duration every .5 seconds when counting 60 Hz.

This basic pulse is broken up into two discrete intervals. One interval simultaneously applies an inhibit command to the counter input (1/3 N7411), and a print command, which opens the storage registers such that the decoder drivers look at the counter BCD outputs. On the second interval the 7475 quad latches close, maintaining the information on the decode driver. The counters are reset to zero in preparation for another division process, or count period.

5.4.2.3 Counter Section:

Fifteen elements plus the digital readout devices comprise the count down section. Each N7490 is a basic 4 bit counter producing a BCD output for each 10 input bits. The N7475 elements are quad latches maintaining a continuous readout while a new count takes place. The BCD information is decoded by the DD700 decode drivers, which accept 4 bits of BCD and decode to operate seven segment display readout devices.

5.4.2.4 Counter Input:

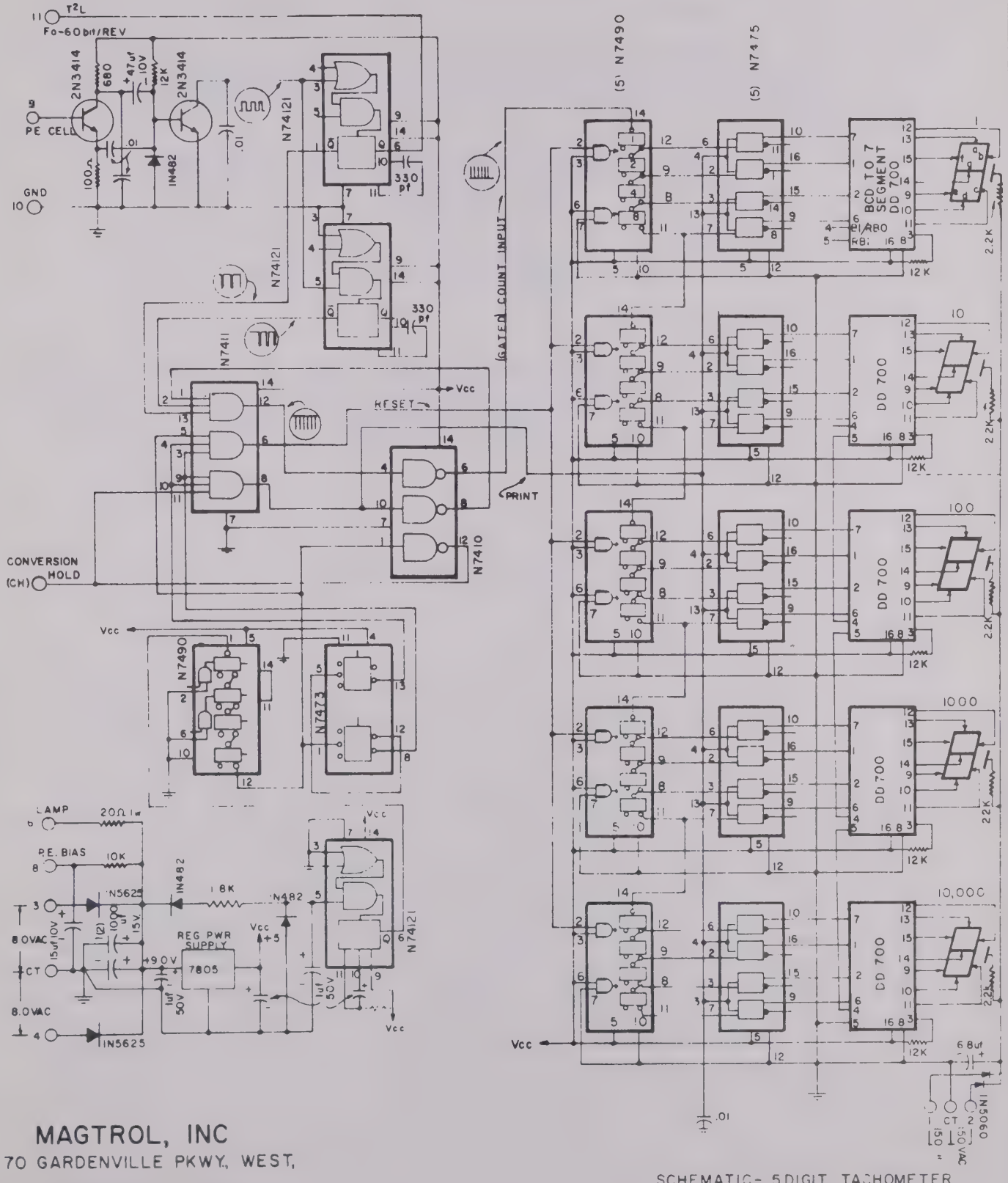
Raw frequency is received from the photo cell located in the dynamometer. The signal is amplified by a 2N3414 transistor, AC coupled to a second 2N3414 transistor. Two N74121 (Schmitt trigger, one shot multivibrators), are triggered by the second 2N3414. One, one shot is triggered by a positive transition. The other N74121 by a negative transition of the input.

The outputs are coupled by a "and" function gate to produce a timed pulse, twice the frequency input. The third input of this gate receives the count inhibit from the time base. The "and" output triggers the least significant digit of the counter section.

5.5 Maintenance:

The tachometer unit does not incorporate any moving parts, nor is there any internal calibration or other adjustments to perform. Therefore, there are no periodic maintenance requirements.

When cleaning the unit, or the Polaroid mask, use a damp cloth, but do not use any solvents that might attack either the paint surfaces or the plastic mask.



MAGTROL, INC

70 GARDENVILLE PKWY., WEST,

BUFFALO, NEW YORK.

SCHEMATIC- 5 DIGIT TACHOMETER

PC. BDS. NO. 78-B-004, 005.

6. MODEL 4603 TORQUE INDICATOR

6.1 General Description:

The Model 4603 is essentially identical to the Model 4605 except that the speed readout section is omitted. This option is made available to cover the following special situations:

a. Where existing Magtrol equipment has speed reading capability and redundancy is unnecessary.

b. Where speed indication is not a factor in test requirements.

c. Where other frequency counters are to be utilized.

6.1.1 Speed Output:

All Magtrol digital dynamometers are equipped with a shaft encoder for speed transducing. The Model 4603 contains the necessary electronics to excite this assembly and provide a frequency output proportional to speed, of 50 or 60 bits per shaft revolution. Therefore, the 4603 reduces to two independent sections.

6.2 Torque Transducing:

This section is identical to that utilized in the Model 4605. Therefore, refer to Section 2.1.1.

6.3 Speed Transducing:

The tachometer pickup is a block consisting of a lamp, photo-cell, resistor and terminals. Referring to Figure 5, the assembly is identified by Magtrol part number 7116, including the pulse disc mounted on the dynamometer shaft. The photo-cell block must be located to place the pulse disc close to the photo-cell window in the approximate center of the 60 bit outside track. The printed side of the disc should be toward the photo-cell for best definition. Since an operating tolerance exists with each photo-cell, the cell current control resistor is also mounted on the block allowing the electronic circuitry to be universal. The disc must clear the photo-cell with all axial tolerance taken up in the direction of contact. (Pulling out on the dynamometer shaft, motor end). However, it should not be spaced away more than .040 inches. Referring to the dynamometer schematic, a regulated potential of +16 VDC is applied to pin 11 at the input connector to the current control resistor mounted on the photo-cell block. The photo diode is in series and is the ground return for the applied voltage. As light causes the cell to conduct (low resistance), the voltage on the signal line and connector pin 10, is low. Alternately, as light is cut off, the signal voltage rises.

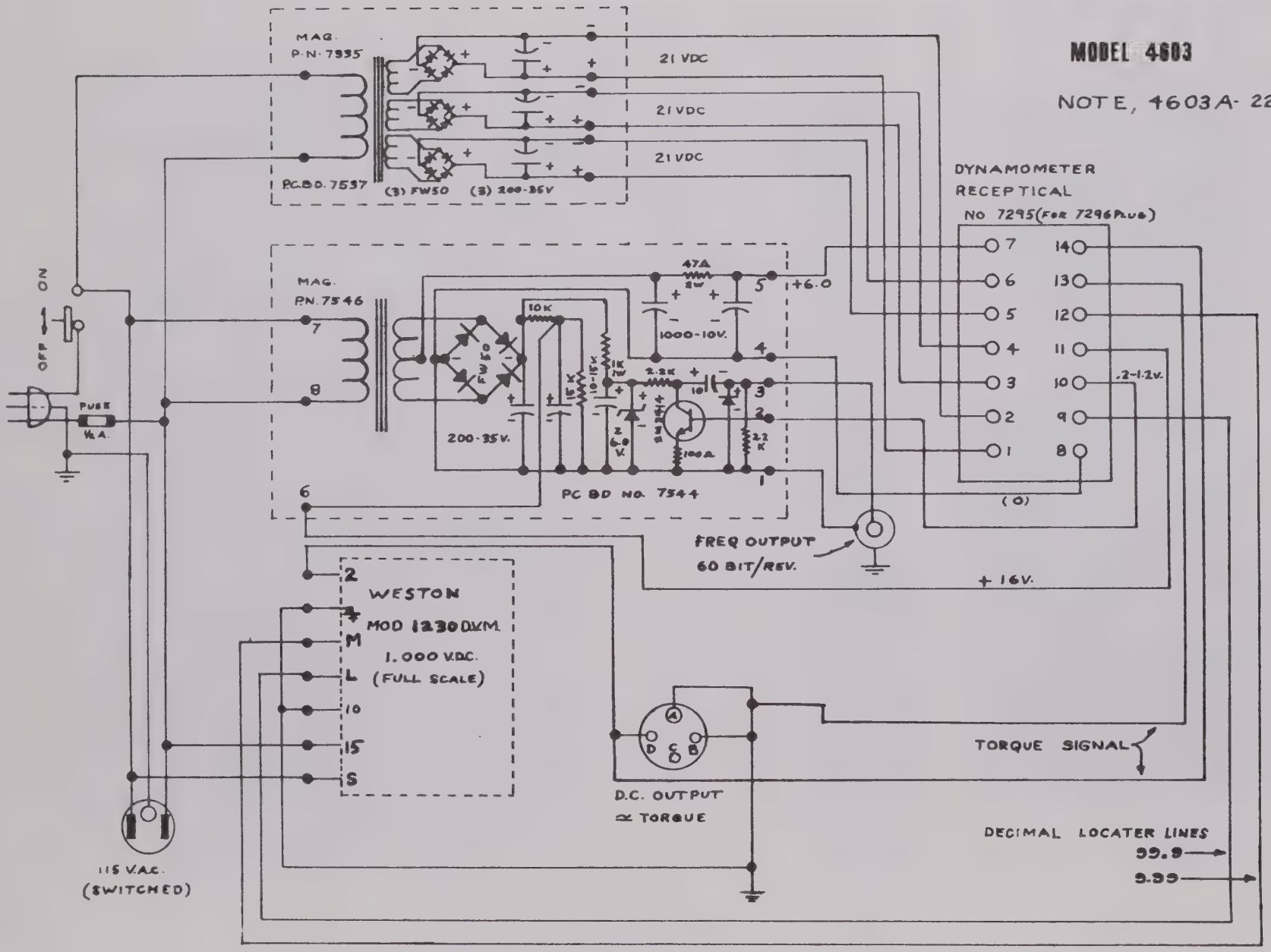
7.3.1 Circuit Description:

Refer to the Model 4603 schematic. As the disc interrupts light, the resulting electrical pulses are applied through pin number 10 of the dynamometer receptacle. This point is wired to pad 2 of the P.C. board number 7544 installed on the back panel of the unit. The electrical signal is amplified to a sharp D.C. pulse train suitable for application to the Magtrol Model 4602 or 4609. The P.C. board number 7544 is a complete electronic package providing all necessary D.C. power to operate the (Part No. 7116) shaft encoder installed in the dynamometer. The pulse train output is available at the miniature phone jack on the rear panel of the 4603. It is identified as "Output for 4609-4602 Speed".

MAGTROL, INC.

MODEL 4603

NOTE, 4603A- 220V. 50 Hz



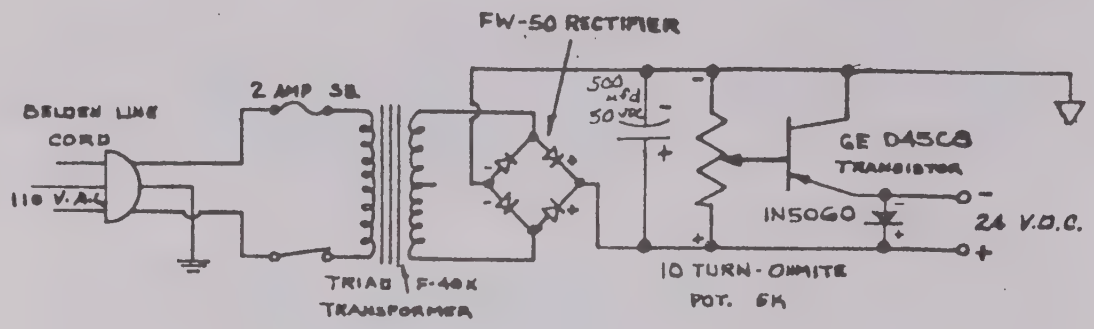
7. POWER SUPPLY MODEL 4636

7.1 General Description:

The dynamometer brake requires an adjustable current for torque control. This current must be D.C., however, due to the large inductance of the brake coil, it need not be pure D.C. The electronic components are housed in an aluminum casting. The unit requires a standard line source.

7.2 Circuit Description:

Refer to drawing number 4636. The dynamometer coil requires a voltage of 0 to 24 V.D.C. This is accomplished by transformer T1, which reduces the line voltage to 24 V.A.C. D1 is a silicon rectifier which converts the 24 V.A.C. to 24 Volts D.C. Potentiometer P1 provides a voltage source to the "Base" element of Transistor Q1 to be adjustable from 0 to 24 V.D.C., relative to common plus side. The "collector" of Q1 is common to the negative source. Therefore, the "emitter" will follow the adjustable voltage with current amplification. The power output is adequate for all dynamometers manufactured by Magtrol. This circuit is protected against short circuit or component failure by a 1 ampere "slow blow" fuse. This fuse is accessible by removing the bottom cover plate.



SCHEMATIC

QTY	IDENT	DESCRIPTION	MAG. P.N.
1	-	TOP PLATE BEZEL	41-0132
1	LC1	LINE CORD	88-M-001
1	C1	ELECT. CAP., 500 MFD 50VDC	70-E-013
1	R1	BRIDGE RECT. FW50	71-B-002
1	R2	G.E. IN5060	71-S-002
1	F	FUSE 1A SB.	72-F-002
1	P1	5K 10T POTENTIOMETER	77-M-014
1	SW	SWITCH SPST.	84-T-002
1	S1	RECEPTICAL C.J. 302 CCT	85-F-006
1	Q1	TRANSISTOR GE. D45C8	86-P-003
1	T1	TRANSFORMER F-40-X	87-V-004

MAGTROL, INC.

MODEL 4636 POWER SUPPLY

8. MODEL 4637 POWER SUPPLY

8.1 General Description:

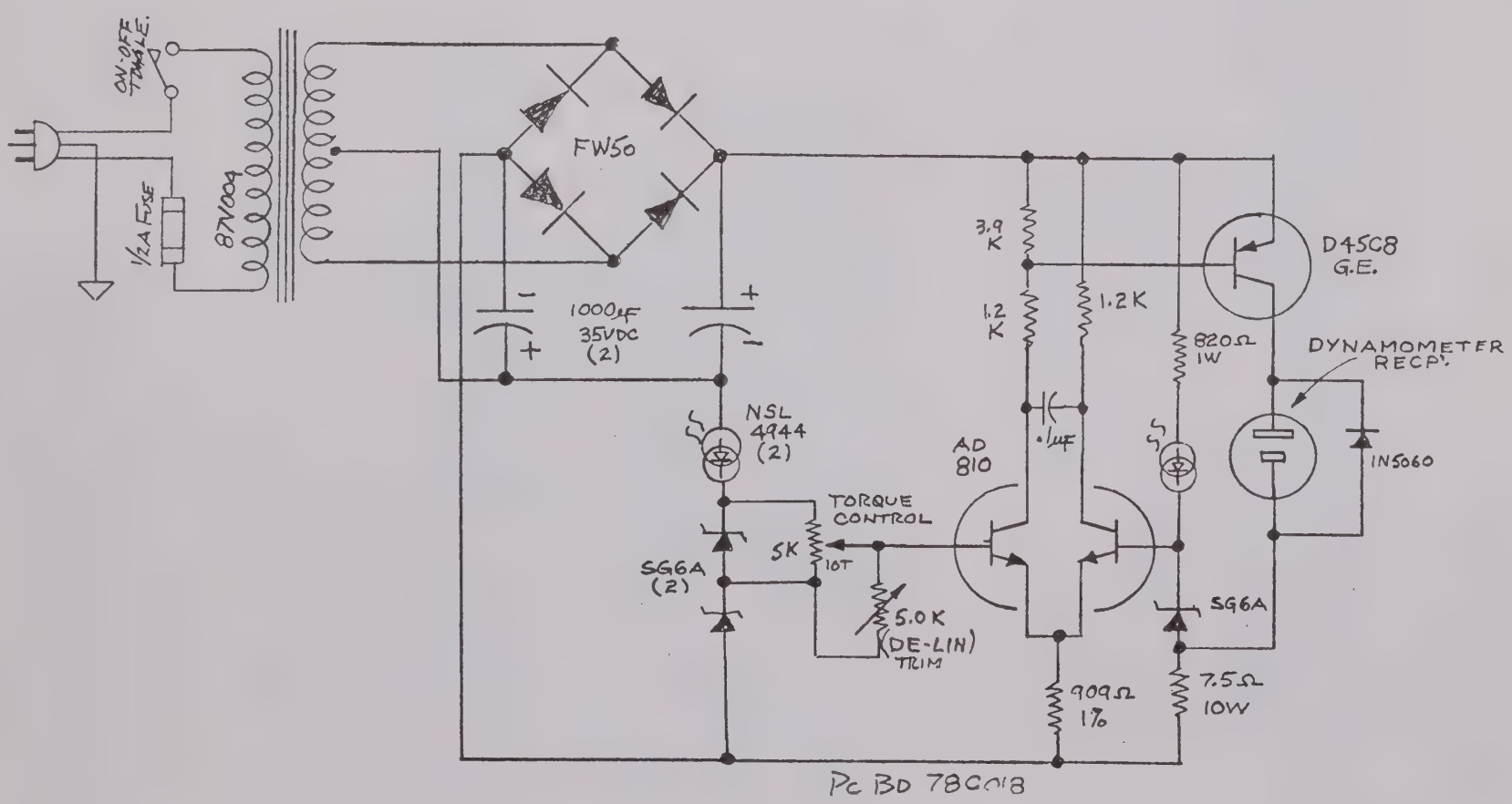
As outlined in paragraph 1.3, the torque level of a hysteresis brake is proportional to the applied current. With the model 4637, total circuit current is sampled and regulated by comparison to a reference. Therefore, for a specific current (or reference) setting, the brake torque remains more nearly constant, since the effects of line voltage fluctuations and brake coil resistance changes are removed.

Only one power supply model is used universally for all dynamometer models, despite the fact that differences in full scale current exist with each specific unit. This characteristic results in less than complete utilization of the ten turn "Torque Level" potentiometer to somewhere between 5 and 9 turns for full scale, dependent upon dynamometer model.

8.2 Circuit Description:

Refering to the schematic diagram for the Model 4637, line power is reduced and rectified by the transformer and FW 50 bridge rectifier. An adjustable reference is obtained by clamping the voltage across the ten turn 5.0 K "Torque Control" potentiometer to 6.2 V.D.C. by the SZ6A zener diode. This voltage is compared to the voltage developed across the 7.5 ohm 10 watt resistor. Current is applied proportionally to the two D45C8 transistor setup as a Darlington pair, to maintain the voltage dropped across the 7.5 ohm resistor equal to the reference voltage. Since the output (D45C8) transistors, dynamometer brake and the 7.5 ohm resistor are in series, then the voltage developed across the resistor is equal to the dynamometer and total circuit current.

In order to more nearly linearize the dynamometer torque characteristic, an adjustable 5K trim pot is placed across the center tap to common of the "Torque Control" potentiometer. The trim pot is factory adjusted on the printed circuit board and should not be adjusted lower than 2.5 K.



MAGTROL, INC.
Model 4637
torque control.

MAGTROL WARRANTY

MAGTROL, INC., warrants that any equipment of our manufacture will be free of manufacturing or component defects to the extent that we will unconditionally guarantee equipment for a period of 90 days from date of receipt by the customer.

ADDITIONALLY, any repairs which may become necessary beyond the 90-Day Unconditional Warranty Period will be made subject to review by our Quality Control Department.

MAGTROL, INC.